

PATENT SPECIFICATION

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- (21) Application No. 472/76 (22) Filed 7 Jan. 1976
 (31) Convention Application No. 546 636
 (32) Filed 3 Feb. 1975 in
 (33) United States of America (US)
 (44) Complete Specification published 16 Aug. 1978
 (51) INT CL³ A23C 19/12
 (52) Index at acceptance A2B 14



(54) CHEESE PRODUCT CONTAINING SOLUBLE PARTIALLY DELACTOSED WHEY

(71) We, STAUFFER CHEMICAL COMPANY, a corporation organised under the laws of the State of Delaware, United States of America, of Westport, Connecticut 06880, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a cheese product containing a soluble partially delactosed whey.

As used herein the term "cheese product" is meant to include pasteurized process cheese, pasteurized for cheese food and spread and imitation cheese spread products which are all well known in the art, e.g. Webb *et al.*, "Fundamentals of Dairy Chemistry", Chapter 2, AVI Publishing Co., Westport, Conn. (1965).

Pasteurized process cheese contains a blend of fresh and aged natural cheeses and up to 3% emulsifier. The blend is pasteurized at from 155 to 160°F., packaged and cooled, after which no further ripening occurs. If desired, a number of optional ingredients including colouring, salt and preservatives may be added. A typical composition will have a minimum fat content, based upon total solids, of about 47% and a maximum moisture content of about 40%. The minimum pH will be about 5.3. A recent reference which further describes this type of cheese is U.S. Patent No. 3,697,292.

Pasteurized process cheese food is prepared in much the same way as the pasteurized process cheese, except that it contains less cheese with either non-fat dry milk solids and/or whey solids and water added. The processing temperature is from 170 to 180°F. and a typical product has a maximum moisture content of about 44%, a minimum fat content of about 23%, based on the weight of the final cheese, and a minimum pH of about 5.0. This product is generally sold in acid form.

Pasteurized process cheese spread is made in much the same manner as the pasteurized process cheese food, but it generally contains

more moisture and has a lower milk fat content. A stabilizer, such as carob bean gum or sodium alginate, is used in the preparation of the product to prevent separation of ingredients. It is usually processed at from 185 to 195°F., has a moisture content of from 44 to 60%, a minimum fat content of about 20%, based on the final cheese, and a minimum pH of about 4.0. It is generally sold in loaf form.

Imitation cheese spread generally comprises from 5 to 30% vegetable oil, from 35 to 60% protein and from 2.5 to 70% water. An example of such a product is described in U.S. Patent No. 3,310,406.

It has been found that when a soluble partially delactosed whey product derived as from a by-product from processing of cheese whey through a molecular sieve resin, as will be described in greater detail below, and an emulsifier mixture comprising sodium aluminium phosphate (SALP), basic, and an alkali metal or alkaline earth metal citrate are incorporated in any of the above-enumerated cheese products in the amounts described below, a final product is produced which has desirable melt, hardness, fat stabilization and smoothness characteristics. This whey product, for example, serves as a replacement for the rather expensive non-fat dry milk solids used in some of the above-described cheese products as a source of protein.

The present invention provides a cheese product containing a soluble partially delactosed whey derived from processing of cheese whey with a molecular sieve resin, the said soluble partially delactosed whey having the following approximate composition in %, by weight:

Lactose, %	40—50	
Minerals, %	20—35	
Protein, (N × 6.38) %	15—20	
Lactic Acid, %	7—10	90
Citric Acid, %	3—6	
Fat, %	less than 1	
Moisture, %	less than 5	
pH	6.6—7.2	

the cheese product also containing an effective amount for emulsification of the cheese product of a mixture of sodium aluminum phosphate, basic, and an alkali metal or alkaline earth metal citrate.

The present invention also provides a process for the preparation of such a product which comprises adding the said mixture to the said cheese product.

The amount of partially delactosed whey product added according to the present invention may range from 1 to 12% and may be used as either a partial replacement for the non-fat dry milk solids or total replacement for the conventional whey products used in the pasteurized process cheese food or spread products described above. A preferred range for such partial replacement is from 1/2 to 1/3 of the non-fat dry milk normally present therein. The emulsifier is present in an amount of between 1.5 to 3%, preferably from 2 to 3%, by weight, of the cheese product. When imitation cheese products are used, the amount of whey solids added according to the present invention may range from 1 to 20% by weight, of the cheese product.

The partially delactosed whey product used according to the present invention will enhance the flavour of the above-described cheese products. If sodium chloride is present in such formulations, a detectable salty taste will be noted.

The partially delactosed whey product used herein is broadly described for use as an additive to a variety of food products, including cheese products, in U.K. Patent No. 1,404,116 (U.S. Patent No. 3,930,056). It is the low molecular weight or water-soluble, low protein, high ash fraction (from 5 to 10% solids) obtained as the by-product of passing partially delactosed cheese whey mother liquor through a molecular sieve resin in accordance with the teachings of U.S. Reissue Patent No. 27,806. It has a solids composition of mainly lactose and minerals (or ash) with residual protein. A typical analysis of such a product is:—

Lactose, %	40—50
Minerals, %	20—35
Protein, (N × 6.38)	15—20
Lactic Acid, %	7—10
Citric Acid, %	3—6
Fat, %	less than 1
Moisture, %	less than 5
pH	6.6—7.2

("N × 6.38" refers to the milk portion expressed in terms of the nitrogen content multiplied by a factor of 6.38).

A typical composition for its mineral or ash component is: sodium—6.5%; potassium—6.6%; calcium—0.3%; phosphorus—1.2%;

magnesium—0.14%; less than 5 ppm heavy metals, e.g., lead. It is available commercially as "ENR—EX" from Stauffer Chemical Co., Food Ingredients Division, Westport, Connecticut, U.S.A.

The emulsifier mixture which is to be used herein comprises sodium aluminum phosphate, basic, and an alkali metal or alkaline earth metal citrate. The weight ratio of SALP to citrate may range from 9:1 to 1:9, with from 5:1 to 1:5 being preferred. The citrate may be sodium citrate, the preferred compound, or potassium citrate or calcium citrate. SALP is available commercially as "KaseP".

The following Examples illustrate the present invention:

EXAMPLE 1.

A series of cheese foods were prepared using a variety of emulsifiers and a soluble partially delactosed whey which is available commercially as "ENR—EX" from Stauffer Chemical Co., Food Ingredients Division, Westport, Connecticut, U.S.A.

The basic cheese food formulation comprised the following ingredients:

Ingredient	Amount (%, by weight)
Cheddar Cheese (2—3 weeks old)	69.0
Soluble partially delactosed	
Whey	10
Emulsifier*	"
Water	17
Heavy Cream**	0.13
Citric Acid	0.03
Potassium Sorbate	0.02

* see Table 1 for the type and amount.

** butter fat content from 34 to 38%, generally about 37.6%.

The cheddar cheese, emulsifiers, dissolved partially delactosed whey and the heavy cream dissolved in the water, and then the citric acid and the potassium sorbate were added to the bowl of a Brabender (Registered Trade Mark) Plastograph which had been preheated to 190°F. The raw cheese has a moisture content of approximately 36—37%. In order to reach the maximum moisture content of 44% allowed in the U.S.A. for cheese food, additional water in an amount of 16—17% was added. About 5% of the added water was in the form of steam and was added throughout the entire processing period. The pre-dissolving of the partially delactosed whey in water enhanced the dispersibility of the whey in the cheese during processing so that better emulsification in the final product was obtained.

The mixing was at 150 envelopes/min. for 3 min. and the product had a final temperature of about 173°F. The cheese was then

sheeted inside a polyvinylidene chloride trans-
parent wrap into 2/10 inch slices and was
cooked immediately and stored in a refrigerator
at 5°C.

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TABLE I

Emulsifier	%	pH	Hardness*		% Melt**	
			Initial	Four Weeks	Initial	Four Weeks
1. Sodium aluminum phosphate (SALP)	2.5	6.2	213	209	86	97
Sodium citrate	0.5					
2. SALP	1.2	6.2	273	218	112	96
Insoluble sodium metaphosphate [IMP] (60%)	1.8					
Trisodium phosphate [TSP] (40%)						
3. IMP (30%) and disodium phosphate [DSP] (70%)	3.0	6.1	114	147	11	13
4. Same as No. 3	2.15	6.0	214	178	10	40
5. IMP (30%) and DSP (70%)	1.0					
IMP (60%) and DSP (40%)	2.0	6.3	163	170	12	13
6. IMP (30%) and DSP (70%)	2.0					
IMP (60%) and TSP (40%)	1.0	6.1	196	158	26	15
7. IMP (30%) and DSP (70%)	1.8					
SALP ("Kasal")	1.2	6.2	203	206	8	14

* Hardness was evaluated as the distance (in 1/10 mm units) of penetration into overlapped cheese slices in 10 seconds by a penetrometer cone loaded with 20 g. Higher numbers indicate a softer cheese product. A reading of about 160-220 is acceptable.

** Melt was evaluated by measuring the % increase in size of a 1/5" thick and 1 3/16" diameter cheese plug when heated in a 450°F. oven for three minutes. A reading of 60-120% is acceptable.

- The data demonstrate that the emulsifier compositions numbered 3 to 7 in the above Table all had an undesirably low degree of melting. Although both of the first two emulsifier combinations gave acceptable melt characteristics, only the first emulsifier composition gave a cheese having an acceptable degree of hardness. The second emulsifier gave a product having a certain degree of undesired initial softness which, for example, would complicate the handling and wrapping of cheese slices.

EXAMPLE 2.

- A series of cheese foods were prepared using the sodium aluminum phosphate/alkali metal citrate emulsifier system according to the present invention and the physical characteristics of each was measured.

- To form the cheese foods (1 lb. batches) a Brabender Plastograph was preheated to 190°F. and cheddar cheese, emulsifying salts and sodium chloride, dissolved non-fat dry milk, or their replacers, and heavy cream in water and citric acid and potassium sorbate were added. The following Table (Table 2) shows the amounts which were used based on the total weight of the ingredients:

Table 2.

- | Ingredient | Amount
(%, by weight) |
|--------------------------------|--------------------------|
| Cheddar Cheese (2—3 weeks old) | 69 |
| Non-Fat Dry Milk Solids and/or | |

Whey Product*	10	
Sodium aluminum phosphate	2.5	35
Sodium citrate	0.5	
NaCl	0.5	
Heavy Cream	0.13	
Citric Acid	0.17—0.34	
Potassium sorbate	0.02	40
Water	17	

* see Table 3 below for further details.

The citric acid was used to adjust the pH of the final cheese to 5.8. The salt is not needed if the whey product used herein replaces the non-fat dry milk solids. The water is added to give a final moisture content of about 44% in the cheese product. About 5% of the water was added during the entire processing period as steam.

The mixture is processed by mixing at a rate of about 150 envelopes/minute for about three minutes. The final temperature of the mixture is from 172 to 173°F. and the mixture has a moisture content of from 43.4 to 44.1% and a pH of from 5.7 to 5.8. At the end of the process the melted cheese was sheeted manually inside a polyvinylidene chloride transparent wrap, into 2/10-inch thick slices. These slices were then immediately cooled and stored in a refrigerator at about 5°C.

The Table below (Table 3) sets forth the physical properties for samples containing a variety of non-fat dry milk solids and/or whey product components:

TABLE 3

Component	Brabender Unit ^a Consistency	Melt (%) ^b		Hardness ^c		Flat ^d Stabilization	Slice Smoothness ^d	Break ^d	Resiliency ^d
		Initial	4 Week	Initial	4 Week				
1. Non-fat Dry Milk Solids (NFDM)	220	119	98	163	195	5	4	3	3
2. Soluble partially delactosed Whey ("ENR-EX")	130	92	100	193	236	5	3	3	4
3. "ENR-EX"/NFDM (50:50)	300	103	93	193	218	4	4	3	3
4. "ENR-EX"/Insoluble partially delactosed whey ^e (50:50)	190	107	118	197	216	5	3	3	3

^a the numbers represent units on the scale on a chart supplied for use with the Brabender plastograph. Similar numbers indicate a similar consistency.

^b evaluated as described in Table 1.

^c evaluated as described in Table 1.

^d evaluated subjectively on a scale of 0 to 5 with 5 being the most desired.

^e Obtained by treating an aqueous solution in accordance with U.S. Patent No. 3,560,219.

The above data demonstrate the superior results that are obtained when a sodium aluminum phosphate/citrate emulsifier is used in accordance with the present invention.

EXAMPLE 3.

- 5 A chemical analysis of the whey product used in accordance with the present invention ("ENR-EX") and with conventional dried whey and non-fat dry milk (NFDM) additives that have been used in cheese products, as that term is defined herein, was performed. The Table sets forth the results:

Component	"ENR-EX"	% Dried	
		Whey	NFDM
Protein	15.6	12	36
Lactose	44.1	72	52
Minerals	24.9	8	8.2
Fat	0.2	1.25	0.8

- 15 The above data show, among other things, the relatively high ash (mineral) content of the whey product used herein. Due to its high ash content, e.g. phosphorus content, the whey product used herein has been found to emulsify and stabilize the fat in cheese in a similar fashion as do conventional cheese emulsifying salts.

(Unless indicated otherwise, all percentages referred to herein are calculated on a weight basis).

- 25 WHAT WE CLAIM IS:—

1. A cheese product containing a soluble partially delactosed whey derived from processing of cheese whey with a molecular sieve resin, the said soluble partially delactosed whey having the following approximate composition in %, by weight:

35	Lactose, %	40—50
	Minerals, %	20—35
	Protein, (N \times 6.38)%	15—20
	Lactic Acid, %	7—10
	Citric Acid, %	3—6
	Fat, %	less than 1

Moisture, % less than 5
pH 6.6—7.2

the cheese product also containing an effective amount for emulsification of the cheese product of a mixture of sodium aluminium phosphate, basic, and an alkali metal or alkaline earth metal citrate.

2. A product as claimed in claim 1 in which the amount of the said mixture present is from 1.5 to 3%, by weight, of the cheese product.

3. A product as claimed in claim 2 in which the amount of the said mixture present is from 2 to 3%, by weight, of the cheese product.

4. A product as claimed in any of claims 1 to 3 in which the weight ratio of sodium aluminium phosphate to citrate in the said mixture is from 9:1 to 1:9.

5. A product as claimed in claim 4 in which the said weight ratio is from 5:1 to 1:5.

6. A product as claimed in any of claims 1 to 5 in which the citrate is sodium citrate, potassium citrate, calcium citrate or a mixture of two or more thereof.

7. A product as claimed in claim 1 substantially as herein described.

8. A product as claimed in claim 1 substantially as herein described with reference to any one of the Examples.

9. A process for the preparation of a product as claimed in claim 1 which comprises adding the said mixture to the said cheese product.

10. A process as claimed in claim 9 substantially as herein described.

11. A process as claimed in claim 9 substantially as herein described with reference to any one of the Examples.

12. A product when prepared by a process as claimed in any of claims 9 to 11.

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